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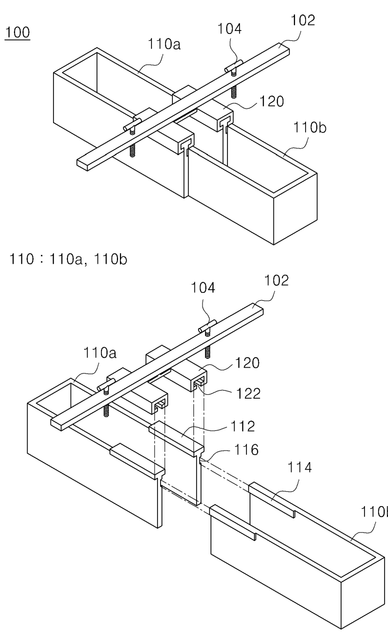
(54) **STRUCTURE FOR CASTING, AND CASTING METHOD USING SAME**

(57) The present disclosure relates to a structure for casting. Defects of a slab may be restricted by effectively forming a concentrated layer containing alloying elements on a surface of the slab using a structure including a support bar mounted to a mold, a hollow partition member having opened upper and lower portions, and a fixing member configured to connect the partition member to the support bar, thereby dividing an inner space of the mold.

Fig.5



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a structure for casting and a casting method using same, and more particularly, to a structure for casting capable of restricting a defect of a slab, and a casting method using same.

BACKGROUND ART

[0002] In general, a slab is manufactured such that molten steel accommodated in a mold is cooled while passing through a cooling zone. For example, a continuous casting process produces various shaped half-finished products such as a slab, a bloom, a billet, and a beam blank by injecting molten steel to a mold having a predetermined inner shape and continuously drawing a slab, which is half-coagulated in the mold, to a lower side of the mold.

[0003] In the above-described casting process, coagulation of the slab is performed such that the slab is primarily cooled in the mold and secondarily cooled by spraying water to the slab after the slab passes through the mold. In the above-described process, the primary cooling generated in the mold is greatly affected by molten steel flow in the mold, molten flow of mold flux, and a uniform permeation capability between the mold and the slab.

[0004] On the other hand, a defect may be generated in the slab manufactured by the casting process due to various reasons. The defect may be generated by the flow of the molten steel in the mold, a load caused by a roll during casting, or a load caused by drawing. In particular, the defect caused by the flow of the molten steel is generally generated in a state in which inclusions and slag are mixed. However, the defect caused by the load of the roll during casting or the load due to drawing may be generally generated in a form of crack in a surface of the slab, and the crack, which is formed in the surface of the slab, may be also generated while the molten steel is the primarily cooled in the mold.

[0005] In recent years, marine structural steel is added with copper (Cu) for the purpose of securing weldability and low temperature resistance. However, copper is eluted to a surface of the slab and then permeated to a grain boundary of steel, thereby generating a crack in a process of casting the slab at a high temperature of about 1500°C. Also, a crack sensitivity of steel sharply increases due to the copper, and a main factor for this is enrichment of copper due to selective oxidation generated during heating for casting or rolling. Since copper has extremely low oxygen affinity, copper is difficult to be removed even during oxidation refining, and thus continuously concentrated. Accordingly, when steel containing copper is used as a scrap during a casting process, the above-described phenomenon is repeatedly generated. Thus, for restricting the phenomenon of dilution of copper from the surface of the slab, a method for increasing solubility of copper in the slab by adding nickel (Ni) at 1.5 to 2 times greater in quantity with respect to a content of copper contained in the steel has been used. However, since nickel is extremely high in price, nickel is a main factor increasing production costs. Thus, a method for restricting surface defects of the slab while reducing the usage quantity of nickel is required.

(Prior art document)

[0006]

Korean Laid-Open Patent No. 2012-0053742
Korean Registered Patent No. 1349918
Korean Registered Patent No. 1371959

DISCLOSURE OF THE INVENTION

TECHNICAL PROBLEM

[0007] The present disclosure provides a structure for casting, which is capable of restricting or preventing a defect generated in a slab to improving a process efficiency and productivity, and a casting method using same.

[0008] The present disclosure also provides a structure for casting capable of reducing a usage amount of a material to save a production cost, and a casting method using same.

TECHNICAL SOLUTION

[0009] In accordance with an exemplary embodiment, a structure for casting, which is installed on a mold during casting, includes: a support bar mounted to the mold; a hollow partition member having opened upper and lower portions; and a fixing member configured to connect the partition member to the support bar, thereby dividing an inner space of the mold.

[0010] The partition member may include a first partition member and a second partition member, each of which has a 'ㄷ' shape in which one side is opened, and the first partition member and the second partition member may define an inner space such that at least a portion of each of the first partition member and the second partition member overlaps in a width direction of the mold.

[0011] The fixing member may be disposed in parallel to the width direction of the mold, and the partition member may be connected to the fixing member to move in the width direction of the mold.

[0012] The partition member may include a first partition member and a second partition member, each of which has a 'ㄷ' shape in which one side is opened, and the first partition member and the second partition member may define an inner space such that at least a portion of each of the first partition member and the second partition member overlaps in a longitudinal direction of the mold..

[0013] The fixing member may be disposed in parallel to the longitudinal direction of the mold, and the partition member may be connected to the fixing member to move in the longitudinal direction of the mold.

[0014] The support bar may extend in one direction to be seated on an upper portion of the mold and be movable in a vertical direction.

[0015] Each of the support bar and the fixing member may include a non-magnetic material.

[0016] The partition member may have apparent porosity of approximately 10% to approximately 20%, and the partition member may have a bending strength of approximately 100 kg/cm^2 to approximately 200 kg/cm^2.

[0017] The partition member may include approximately 2 mass% to approximately 6 mass% of SiO_2, approximately 60 mass% to approximately 82 mass% of ZrO_2, approximately 15 mass% to approximately 30 mass% of carbon, and approximately 1 mass% to approximately 4 mass% of antioxidant on the basis of total approximately 100 mass%.

[0018] The antioxidant may include at least one of Si, Al, and Ti.

[0019] The partition member may include approximately 99 wt% or more of AlN and less than approximately 1 wt% of unavoidable impurities on the basis of total approximately 100 mass%.

[0020] In accordance with another exemplary embodiment, a casting method includes: preparing a structure including a hollow partition member having opened upper and lower portions; installing the structure so that the partition member disposed on an upper portion of a mold divides an inner space of the mold; adjusting a length of the partition member in a width direction or longitudinal direction of the mold so that the partition member is spaced apart from an inner wall of the mold; injecting molten steel to the mold; providing mold flux to an upper portion of the molten steel; and casting a slab by coagulating the molten steel. Here, in the installing of the structure, the inner space of the mold is divided into a first area defined in the partition member and a second area defined between the partition member and the inner wall of the mold.

[0021] In the installing of the structure, at least a portion of the partition member may contact the molten steel, and at least a portion of the partition member may contact the mold flux.

[0022] The installing of the structure may include arranging the partition member on each of both sides of a submerged nozzle that injects the molten steel to the mold.

[0023] In the installing of the structure, a distance between the inner wall of the mold and the partition member may be maintained in a range from approximately 20 mm to approximately 100 mm.

[0024] In the installing of the structure, the partition member may be submerged from a melting surface of the molten steel in a range from approximately 20 mm to approximately 200 mm.

[0025] The providing of the mold flux may include injecting mold fluxes, which are different in kind, to the first area and the second area, respectively.

[0026] The mold flux injected to the second area may include nickel oxide.

[0027] The casting of the slab may include continuously injecting mold flux to the second area.

ADVANTAGEOUS EFFECTS

[0028] The structure for casting and the casting method using same in accordance with the exemplary embodiment may easily form the concentrated layer including alloying elements on the surface of the slab. That is, the inner space of the mod may be divided by using the structure during casting, and mold fluxes having different elements may be provided to the divided spaces, respectively. Here, the concentrated layer containing alloying elements may be selectively formed on the surface of the slab by selectively injecting the mold flux containing alloying elements between the inner wall of the mold and the structure. As dilution caused by the molten steel is restricted by the alloying elements in the mold flux, most of the alloying elements may contribute to formation of the concentrated layer, and, through this, the concentrated layer having a target concentration may be formed on the surface of the slab.

[0029] Also, the usage quantity of the alloying elements used for restricting surface defects of the slab may be reduced to save the production costs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

FIG. 1 is a schematic view illustrating casting equipment.

FIG. 2 is a schematic perspective view illustrating a state in which a structure for casting is applied to a mold in accordance with an exemplary embodiment.

FIGS. 3 and 4 are schematic cross-sectional views illustrating a state in which a structure for casting is applied to a mold in accordance with an exemplary embodiment.

FIG. 5 is a view illustrating a constitution of a structure for casting in accordance with an exemplary embodiment.

FIGS. 6 to 8 are views illustrating a usage state of a structure for casting in accordance with an exemplary embodiment.

FIG. 9 is a graph showing results obtained by comparing depths of concentrated layers of surfaces of slabs according to whether the structure in accordance with an exemplary embodiment is used.

FIG. 10 is a graph showing results obtained by comparing rates of remained Ni in the surface layers of the slabs according to whether the structure in accordance with an exemplary embodiment is used.

MODE FOR CARRYING OUT THE INVENTION

[0031] Hereinafter, preferred embodiments will be described in detail with reference to the accompanying drawings. The present disclosure may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the concept of the invention to those skilled in the art.

[0032] FIG. 1 is a schematic view illustrating casting equipment, FIG. 2 is a schematic perspective view illustrating a state in which a structure for casting is applied to a mold in accordance with an exemplary embodiment, FIGS. 3 and 4 are schematic cross-sectional views illustrating a state in which a structure for casting is applied to a mold in accordance with an exemplary embodiment, FIG. 5 is a view illustrating a constitution of a structure for casting in accordance with an exemplary embodiment, and FIGS. 6 to 8 are views illustrating a usage state of a structure for casting in accordance with an exemplary embodiment.

[0033] Referring to FIG. 1, the casting equipment may include: a ladle 10 in which molten steel, which is refined in a steelmaking process; a tundish 20 receiving molten steel through an injection nozzle connected to the ladle 10, e.g., a shroud nozzle (not shown), then temporarily storing the received molten steel, and then providing the molten steel to a mold 30; a mold 30 receiving the molten steel through a submerged nozzle 22 connected to the tundish 20 and forming a coagulation layer in a predetermined shape; and a cooling line 40 provided below the mold 30 and including a plurality of segments, which are continuously arranged to perform a series of molding works while cooling a coagulated slab 1 drawn from the mold 30.

[0034] In a casting process using the above-described casting equipment, when molten steel M accommodated in the tundish 20 is injected to the mold 30, mold flux may be provided to an upper portion of the molten steel injected to the mold 30. The mold flux may be provided to the upper portion of the molten steel in a solid state, e.g., a powder state, or molten mold flux in a liquid state, which is obtained by dissolving the mold flux in a solid state, may be provided.

[0035] As casting proceeds, the mold flux is introduced between the molten steel and an inner wall of the mold 30 by vibration applied to the mold 30 to generate a lubrication action, and the molten steel coagulated in the mold 30, i.e., a coagulated cell, may be drawn to a lower portion of the mold 30. Here, the mold flux may function for absorbing and removing inclusions in the molten steel, warming the molten steel, and controlling a speed of heat transfer in addition to the lubrication action.

[0036] Also, the mold flux may provide a coating layer on a surface of a slab therearound. For example, when the slab is cast by using steel containing a great quantity of copper, as the copper elements are oxidized while being eluted to the surface of the slab, a crack may be generated on the surface of the slab. Thus, as a concentrated layer containing nickel, i.e., a coating layer, is provided to the surface of the slab, the crack generated on the surface of the slab may be prevented. As described above, the mold flux containing nickel oxide is injected to the upper portion of the molten steel to form the concentrated layer containing nickel on the surface of the slab. However, since the mold flux reacts with the inclusions contained in the molten steel during casting, elements thereof may be changed or a concentration thereof may increase, so that the concentrated layer having a desired concentration may be difficult to be formed.

[0037] Thus, in accordance with an exemplary embodiment, variation in elements or concentration of the mold flux may be minimized, and the concentrated layer having a desired concentration may be formed on the surface of the slab by dividing an inner space of the mold using a structure for casting and selectively providing mold flux having different elements to the divided spaces, respectively.

[0038] Referring to FIG. 2, the structure for casting in accordance with an exemplary embodiment may include: a support bar 102 that is able to be mounted to the mold 30; a hollow partition member 110 having opened upper and lower portions; and a fixing member 120 connecting the partition member 110 to divide an inner space of the mold 30. Here, as illustrated in FIGS. 3 and 4, the structure may be symmetrically provided to each of both sides of the submerged nozzle 22 and divide the inner space of the mold 30 into a first area A defined in the partition member 110 and a second area B defined between the partition member 110 and the inner wall of the mold 30. For reference, hereinafter, a longitudinal direction of the mold 30 represents a direction corresponding to a width direction of the slab, and a width direction of the mold 30 represents a thickness direction of the slab. Also, the longitudinal direction of the mold 30 represents a direction in which the slab is drawn.

[0039] The support bar 102 may have a bar shape extending in one direction to seat on an upper portion of the mold 30. The support bar 102 may be provided at one side of the submerged nozzle 22 and seated on the upper portion of the mold along the width direction of the mold 30. The support bar 102 is preferably made of a non-magnetic material so as not to affect an eddy current level meter that measures a molten steel level by using a magnetic field among molten steel level measuring sensors. Here, the non-magnetic material may include titanium.

[0040] Also, the support bar 102 may move in a vertical direction. The support bar 102 may be seated on the upper portion of the mold. Accordingly, an elevation member 104 may be provided to a portion of the support bar 102, which contacts the mold 30, to vertically move the support bar 102. The elevation member 104 may include a bolt that is rotatably provided while passing through the support bar 102. Here, a lower portion of the bolt may contact the upper portion of the mold 30. Also, as illustrated in FIG. 6, the lower portion of the bolt may be inserted to and screw-coupled to the mold 30. In this case, the support bar 102 may move upward or downward according to a degree of the screw-coupling between the bolt and the mold 30. As described above, as the support bar 102 vertically moves by using the elevation member 104, horizontality of the support bar 102 may be adjusted at the upper portion of the mold 30. Also, the support bar 102 may vertically move by a driving unit (not shown) or a gearbox (not shown), which is connected to the support bar 102.

[0041] The partition member 110 may include a first partition member 110a having an approximately 'ㄷ' shape, which has a plate shape having an area and in which one side is opened, and a second partition member 110b having an approximately 'ㄷ' shape in which one side is opened. The first partition member 110a and the second partition member 110b may be arranged so that the opened one sides face each other, and at least portions of the one sides may overlap each other. Thus, the first partition member 110a and the second partition member 110b may form a hollow shape having opened upper and lower portions.

[0042] The partition member 110 may be made of a material capable of sustaining the high temperature molten steel and mold flux in the mold 30 and not reacting with the same. The partition member 110 may be made of a material containing 2 to 6 mass% of SiO_2, 60 to 82 mass% of ZrO_2, 15 to 30 mass% of carbon, and 1 to 4 mass% of antioxidant on the basis of total 100 mass%. When a content of SiO_2 contained in the partition member 110 is less than 2 mass%, a crack may be generated by thermal shock at the beginning of casting, and when greater than 6 mass%, erosion may be excessively generated by the mold flux. Also, when a content of ZrO_2 contained in the partition member 110 is less than 60 mass%, erosion caused by the mold flux may be generated, and when greater than 82 mass%, damage may be generated by thermal shock. When a content of carbon contained in the partition member 110 is less than 15 mass%, a crack may be generated by thermal shock, and when greater than 30 mass%, since the carbon is picked-up to the molten steel, a quality of the molten steel may be degraded, and a property of the molten steel may be harmfully affected. Also, the antioxidant is added to prevent carbon from being oxidized. At least one of Al, Si, and Ti may be used as the antioxidant.

[0043] Alternatively, the partition member 110 may be made of a material containing AlN. Here, the partition member 110 may contain 99 wt% or more of AlN and less than 1 wt% of impurities on the basis of total 100 mass%. When AlN is used for the partition member 110, since almost no risk of oxidation exists, the antioxidant is not contained.

[0044] Also, the partition member 110 may be manufactured to have an apparent porosity of about 10% to about 20% and a bending strength of 100 kg/cm^2 to 200 kg/cm^2. When the apparent porosity of the partition member 110 is less than the above suggested range, as thermal shock resistance is remarkably reduced, a crack may be generated in the molten steel, and thus the molten steel may be damaged. When the apparent porosity of the partition member 110 is greater than the above suggested range, a mechanical property of the partition member 110 may be degraded, and a damage caused by molten steel flow may be generated. Also, when the bending strength of the partition member 110 is less than the above suggested range, damage caused by the molten steel flow may be generated, and when greater than the suggested range, damage caused by the thermal shock may be generated.

[0045] The fixing member 120 may connect the partition member 110 to the support bar 102. Here, the fixing member 120 may connect the partition member 110 to the support bar 102 so that the partition member 110 moves in the width direction or the longitudinal direction of the mold 30. A first guide groove 122, to which one side upper portion of the first partition member 110a is inserted, may be defined in the fixing member 120. Here, a flange 112 may be provided to the one side upper portion of the first partition member 110a to prevent the first partition member 110a from being separated from the fixing member 120. Also, as the flange 112 is inserted to the first guide groove 122, the first partition member 110a may be connected to the fixing member 120 in a slidingly movable manner.

[0046] Also, a projection 114 may be provided to one side surface of the second partition member 110b, which contacts the first partition member 110a. Also, a second guide groove 116, to which the projection 114 is inserted, may be defined in the first partition member 110a. Through the above-described configuration, as the projection 114 of the second partition member 110b is inserted to the second guide groove 116 of the first partition member 110a, the second partition member 110b is coupled to the first partition member 110a in a slidingly movable manner.

[0047] The fixing member 120 is preferably made of a non-magnetic material not to affect the ECLM that measures a level of molten steel by using a magnetic field among molten steel level measuring sensors like the support bar 102. Here, the non-magnetic material may include titanium.

[0048] Also, the partition member 110 may be adjusted in length in the longitudinal direction or width direction of the mold 30.

[0049] Referring to FIG. 7, each of the first partition member 110a and the second partition member 110b may have a rectangular shape elongated in the longitudinal direction of the mold 30. Accordingly, one side of the first partition member 110a and one side of the second partition member 110b may overlap each other, and at least one of the first partition member 110a and the second partition member 110b may move in the longitudinal direction of the mold 30. This is for installing the structure for casting in correspondence to a width of a slab to be cast. For example, when the width of the slab is small, e.g., 900 mm, a degree of overlap between the first partition member 110a and the second partition member 110b may increase, and when the width of the slab is relatively great, e.g., 1500 mm, the degree of overlap between the first partition member 110a and the second partition member 110b may decrease.

[0050] Also, referring to FIG. 8, the first partition member 110a and the second partition member 110b may overlap in the width direction of the mold 30. This is for corresponding to thickness variation of a slab to be cast. For example, the partition member 110 may increase or decrease in length in the width direction of the mold 30 by moving at least one of the first partition member 110a and the second partition member 110b in the width direction of the mold 30, i.e., the thickness direction of the slab.

[0051] Through the above-described configuration, the structure may be installed in quick correspondence to variation in thickness or width of the slab.

[0052] Hereinafter, the casting method in accordance with an exemplary embodiment will be described.

[0053] The casting method in accordance with an exemplary embodiment may include: preparing the structure 100 including the hollow partition member 110 having opened upper and lower portions; installing the structure 100 on an upper portion of the mold 30 so that the partition member 110 divides an inner space of the mold 30; adjusting the length of the partition member 110 in the width direction or longitudinal direction of the mold 30 so that the partition member 110 is spaced apart from an inner wall of the mold 30; injecting the molten steel to the mold 30; supplying mold flux to the upper portion of the molten steel; and casting a slab by coagulating the molten steel. Here, in the installing of the structure, the inner space of the mold may be divided into a first area A defined in the partition member and a second area B defined between the partition member 110 and the inner wall of the mold 30. Since the first area A and the second area B are completely separated from each other, mold flux injected to the first area A and mold flux injected to the second area B may be prevented from being mutually mixed.

[0054] First, the structure 100 is installed on the upper portion of the mold 30 to divide the inner space of the mold 30. Here, as illustrated in FIG. 6, when horizontality of the structure 100 is not balanced, the horizontality may be adjusted by ascending or descending the support bar 102 using the elevation member 104. The structure may be disposed on each of both sides of the submerged nozzle 22, then at least a portion of the partition member 110 may contact the molten steel by the mold flux and the molten steel injected into the mold 30, and at least a portion of the partition member 110 may be installed to contact the mold flux.

[0055] The partition member 110 may be installed to be spaced apart from the inner wall of the mold 30. Here, the partition member 110 may be installed to maintain a spaced distance between the partition member 110 and the mold 30 to be about 20 mm to about 100 mm. More preferably, the partition member 110 may be installed to maintain the spaced distance between the partition member 110 and the mold 30 to be about 50 mm to about 70 mm. Here, when the distance between the partition member 110 and the mold 30 is less than the above-suggested range, the mold flux may not be sufficiently melted by heat of the molten steel, the lubrication action is reduced as an amount of the mold flux injected between the inner wall of the mold 30 and the molten steel, and the desired concentrated layer may be difficult to be formed on the surface of the slab. Also, when the distance between the partition member 110 and the mold 30 is greater than the above-suggested range, as denaturalization of the mold flux by molten steel flow, e.g., a dilution effect of Ni element contained in the mold flux, is generated, the desired concentrated layer is difficult to be formed on the surface of the slab.

[0056] Also, the partition member 110 may be submerged in a ranged of 20 to 200 mm from the melting surface of the molten steel. Although the partition member 110 may be desirably submerged in a range of 50 to 150 mm from the melting surface of the molten steel, the partition member may be submerged in a range of 70 to 120 mm. This is for preventing mixture between mold flux injected to each of the first area A and the second area B while sufficiently maintaining a submerged state even when the level of the molten steel in the mold 30 is varied. However, when the submerged depth of the partition member 110 is greater than the above-suggested range, the partition member 110 may be interfered with the molten steel discharged from the submerged nozzle 22, and heat transfer to the outside from the partition member 110 may be interrupted to form excessive initial coagulations.

[0057] When the partition member 110 is installed to the mold 30, the molten steel and the mold flux are injected into the mold 30 through the submerged nozzle 22. Here, since the inner space of the mold 30 is divided by the partition member 110, the mold flux is necessarily injected to each of the first area A and the second area B. Since the partition member 110 is installed to open an upper portion of each of the first area A and the second area B, the mold flux may be easily injected to each of the areas.

[0058] The outside of the partition member 110, i.e., the second area B, may be injected with the mold flux containing nickel oxide (NiO), e.g., first mold flux. The first mold flux has a function of sufficiently concentrating Ni to only a surface layer, at which initial coagulation is initiated in the mold 30, a function of performing lubrication between the mold 30 and coagulated cells, and a function of controlling heat transfer between the coagulated cells. The first mold flux may include a composition containing SiO_2, CaO, MgO, Al_2O_3, Na_2O, F, and nickel oxide. Here, the nickel oxide may be added at a range of 5 wt% to 40 wt% on the basis of the total weight of the composition. In the first mold flux, MgO may be added at 1.0 to 1.5 wt%, Al_2O_3 at 5 to 7 wt%, Na_2O at 3 to 5 wt%, and F at 5 to 7 wt%, and CaO and SiO_2 may be added so that CaO/SiO_2 have a ratio of 0.8 to 1.4.

[0059] Also, the inside of the partition member 110, i.e., the first area A, may be an area in which coagulation of the molten steel is not proceeded, and injected with second mold flux having a function of preventing the molten steel from being oxidized by contacting the atmosphere, a function of warming not to generate excessive cooling, and a function of collecting inclusions when the inclusions in the molten steel float. Here, since the coagulation of the molten steel is not proceeded in the first area A, the second mold flux is unnecessary to have a function of lubrication and heat transfer control. The second mold flux may be divided into high basic mold flux and low basic mold flux according to the kind of steel that is an object to be cast. Metal in which a large quantity of Al_2O_3 inclusions existed in the molten steel due to Al deoxidation metal and molten Al existed among metal may minimize a content of SiO_2 in the mold flux to restrict a reduction reaction due to the molten Al in the molten steel. Also, floating Al_2O_3 inclusions may be easily absorbed by maintaining high basicity (CaO/SiO_2). For example, high basic mold flux may contain 40 to 60 wt% of CaO, 20 to 40 wt% of Al_2O_3, less than 10 wt% of SiO_2, and the rest of carbon.

[0060] Also, since steel containing a large quantity of SiO_2 in the molten steel due to Si deoxidation includes an extremely small quantity of molten Al, the molten steel may not be reoxidized. Also, low basic mold flux containing a small quantity of Al_2O_3 may be used to minimize mixing of the Al_2O_3 inclusions. For example, the low basic mold flux may contain 30 to 50 wt% of CaO, 40 to 60 wt% of SiO_2, and less than10 wt% of Al_2O_3.

[0061] The second mold flux may have a grain size that has a granular shape having a diameter of 1 to 5 mm to secure a sufficient warming capability.

[0062] Also, since the first area A is surrounded by the partition member 110, the second mold flux injected to the first area A is blocked in introduction between the mold 30 and the molten steel, and is not almost consumed during casting. When the second mold flux is sufficiently injected to the first area A at the beginning of casting, the second mold flux may not be additionally injected to the first area A during the casting. Also, since the first mold flux injected to the second area B is continuously consumed while the casting proceeds, the first mold flux may be continuously injected at an injection speed of 0.2 kg to 1 kg per a ton of molten steel during the casting.

[0063] Hereinafter, experimental examples for evaluating performance of a slab cast in the casting method in accordance with an exemplary embodiment will be described.

[0064] FIG. 9 is a graph showing results obtained by comparing depths of concentrated layers of surfaces of slabs according to whether the structure in accordance with an exemplary embodiment is used, and FIG. 10 is a graph showing results obtained by comparing rates of remained Ni in the surface layers of the slabs according to whether the structure in accordance with an exemplary embodiment is used.

Comparative example

[0065] A specimen is cast by using mold flux containing Al-deoxidized steel and NiO without using the structure in an experimental continuous casting device.

Experimental example

[0066] A specimen is cast while the structure in accordance with an exemplary embodiment is installed to a mold, and molten steel and mold flux are injected to the mold. Here, Al-deoxidized steel is used as molten steel, and high basic mold flux (second mold flux) and mold flux containing NiO (first mold flux) are used.

[0067] Also, a depth of a concentrated layer and a remained rate of Ni in the concentrated layer from the cast specimen are analyzed.

[0068] First, results obtained by measuring the depth of the concentrated layer formed on the surface of the specimen are described below.

[0069] In case of a specimen cast by using the structure (embodiment), as shown in FIG. 9, the concentrated layer is formed at a predetermined depth from the surface of the specimen. In comparison, in case of a specimen cast without using the structure (comparative example), it may be seen that the concentrated layer is formed at a central portion with extremely great depth in a width direction of the specimen, and the depth of the concentrated layer gradually decrease in a direction toward an edge.

[0070] Also, analysis results of the remained rate of Ni in the concentrated layer formed on the surface of the specimen are described below.

[0071] A remained rate (%) of Ni in the concentrated layer is obtained by calculating a portion in which a total quantity of Ni in the inputted mold flux (first mold flux) is contributed to an increased quantity of a Ni content when the surface layer of the cast specimen is analyzed. As a result of the analysis, only about 35 % of total Ni inputted by the mold flux contributes the concentration of Ni in the surface layer of the slab, and in case of the embodiment, about 80% of the total inputted Ni contributes the concentration of Ni in the surface layer of the slab. Through this, it is checked that the desire shaped concentrated layer may be formed on the surface of the slab when the slab is cast by dividing the inner space of the mold by using the structure and selectively injecting mold fluxes, which are different from each other, to the divided areas, respectively.

[0072] As described above, while this invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims. Therefore, the scope of the invention is defined not by the detailed description of the invention but by the appended claims, and all differences within the scope will be construed as being included in the present invention.

INDUSTRIAL APPLICABILITY

[0073] The structure for casting and the casting method in accordance with the exemplary embodiment may be applied to manufacture the slab having excellent quality by restricting generation of surface defect.

Claims

1. A structure for casting, which is installed on a mold during casting, comprising:

a support bar mounted to the mold;
a hollow partition member having opened upper and lower portions; and
a fixing member configured to connect the partition member to the support bar, thereby dividing an inner space of the mold.

2. The structure for casting of claim 1, wherein the partition member comprises a first partition member and a second partition member, each of which has a 'ㄷ' shape in which one side is opened, and
the first partition member and the second partition member define an inner space such that at least a portion of each of the first partition member and the second partition member overlaps in a width direction of the mold.

3. The structure for casting of claim 2, wherein the fixing member is disposed in parallel to the width direction of the mold, and
the partition member is connected to the fixing member to move in the width direction of the mold.

4. The structure for casting of claim 1, wherein the partition member comprises a first partition member and a second partition member, each of which has a 'ㄷ' shape in which one side is opened, and
the first partition member and the second partition member define an inner space such that at least a portion of each of the first partition member and the second partition member overlaps in a longitudinal direction of the mold.

5. The structure for casting of claim 4, wherein the fixing member is disposed in parallel to the longitudinal direction of the mold, and
the partition member is connected to the fixing member to move in the longitudinal direction of the mold.

6. The structure for casting of claim 3 or 5, wherein the support bar extends in one direction to be seated on an upper portion of the mold and is movable in a vertical direction.

7. The structure for casting of claim 6, wherein each of the support bar and the fixing member comprises a non-magnetic material.

8. The structure for casting of claim 1, wherein the partition member has apparent porosity of approximately 10% to approximately 20%, and
the partition member has a bending strength of approximately 100 kg/cm^2 to approximately 200 kg/cm^2.

9. The structure for casting of claim 8, wherein the partition member comprises approximately 2 mass% to approximately 6 mass% of SiO_2, approximately 60 mass% to approximately 82 mass% of ZrO_2, approximately 15 mass% to approximately 30 mass% of carbon, and approximately 1 mass% to approximately 4 mass% of antioxidant on the basis of total approximately 100 mass%.

10. The structure for casting of claim 9, wherein the antioxidant comprises at least one of Si, Al, and Ti.

11. The structure for casting of claim 8, wherein the partition member comprises approximately 99 wt% or more of AlN and less than approximately 1 wt% of unavoidable impurities on the basis of total approximately 100 mass%.

12. A casting method comprising:

preparing a structure comprising a hollow partition member having opened upper and lower portions;
installing the structure so that the partition member disposed on an upper portion of a mold divides an inner space of the mold;
adjusting a length of the partition member in a width direction or longitudinal direction of the mold so that the partition member is spaced apart from an inner wall of the mold;
injecting molten steel to the mold;
providing mold flux to an upper portion of the molten steel; and
casting a slab by coagulating the molten steel,
wherein in the installing of the structure, the inner space of the mold is divided into a first area

defined in the partition member and a second area defined between the partition member and the inner wall of the mold.

13. The casting method of claim 12, wherein in the installing of the structure, at least a portion of the partition member contacts the molten steel, and at least a portion of the partition member contacts the mold flux.

14. The casting method of claim 13, wherein the installing of the structure comprises arranging the partition member on each of both sides of a submerged nozzle that injects the molten steel to the mold.

15. The casting method of claim 13 or 14, wherein in the installing of the structure, a distance between the inner wall of the mold and the partition member is maintained in a range from approximately 20 mm to approximately 100 mm.

16. The casting method of claim 15, wherein in the installing of the structure, the partition member is submerged from a melting surface of the molten steel in a range from approximately 20 mm to approximately 200 mm.

17. The casting method of claim 12, wherein the providing of the mold flux comprises injecting mold fluxes, which are different in kind, to the first area and the second area, respectively.

18. The casting method of claim 17, wherein the mold flux injected to the second area comprises nickel oxide.

19. The casting method of claim 18, wherein the casting of the slab comprises continuously injecting mold flux to the second area.

Fig.1

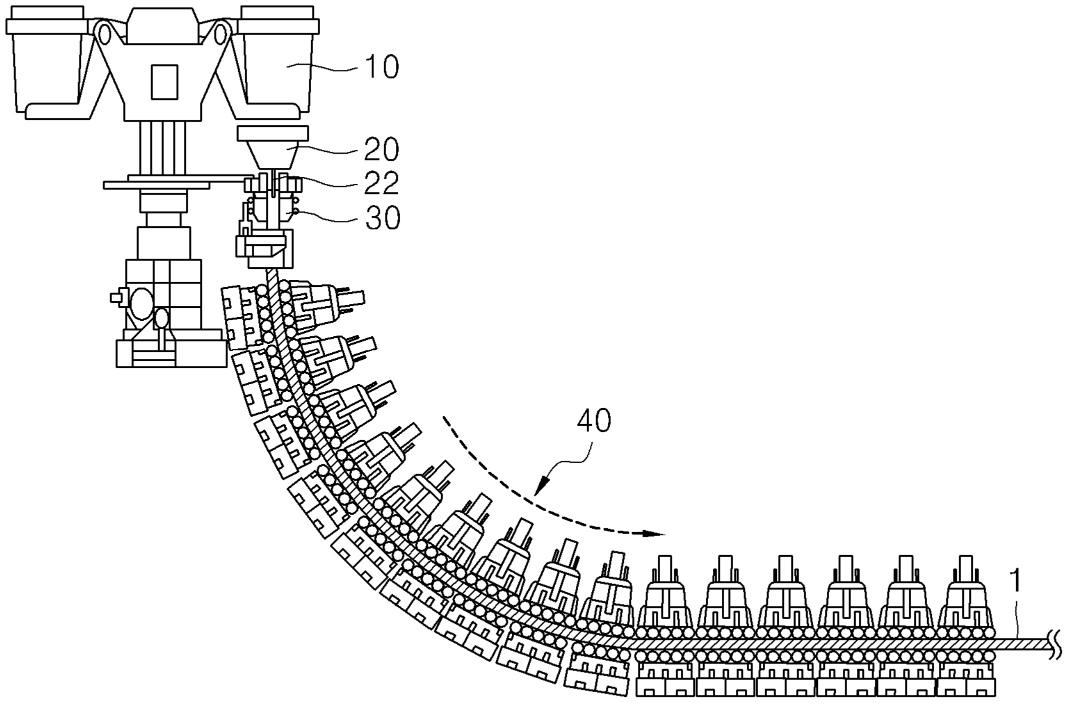


Fig.2

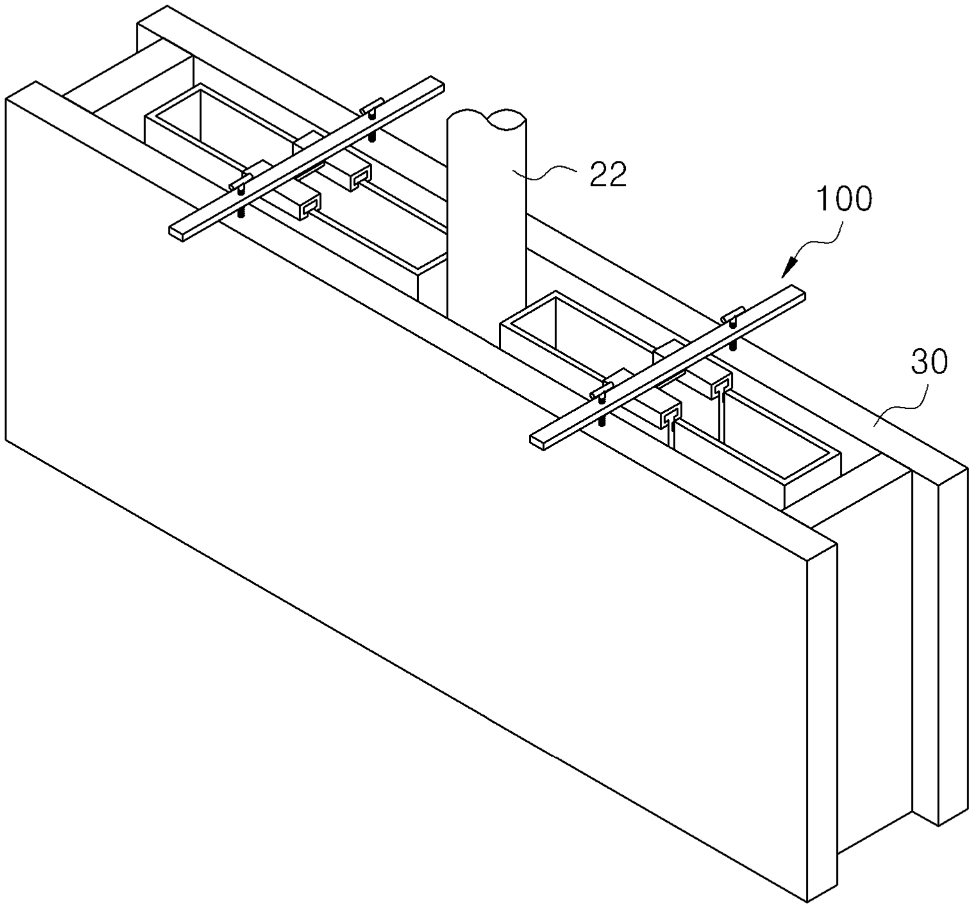


Fig.3

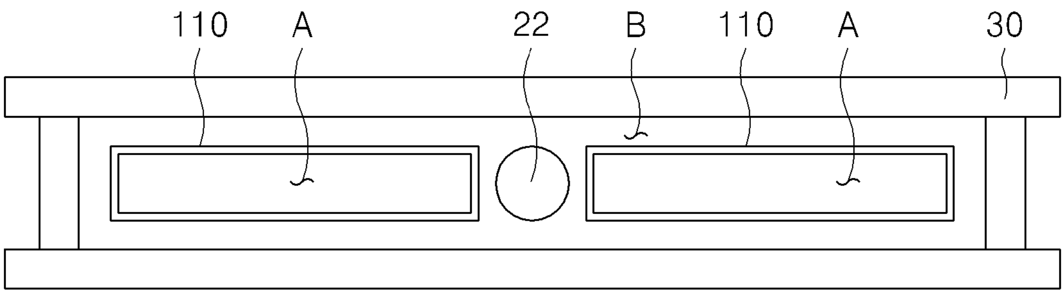


Fig.4

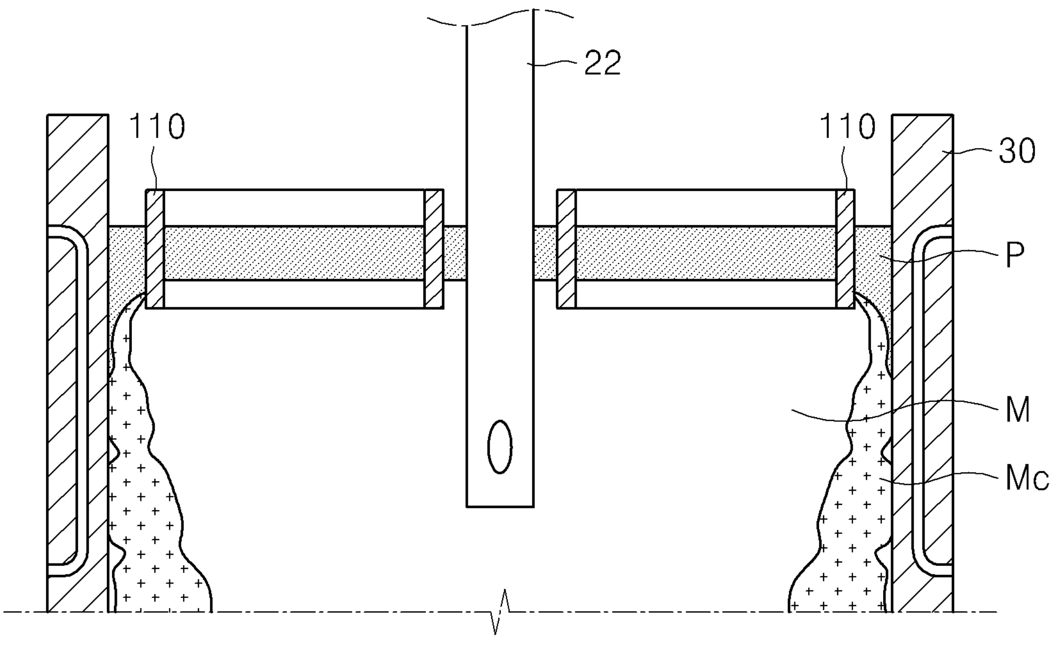


Fig.5

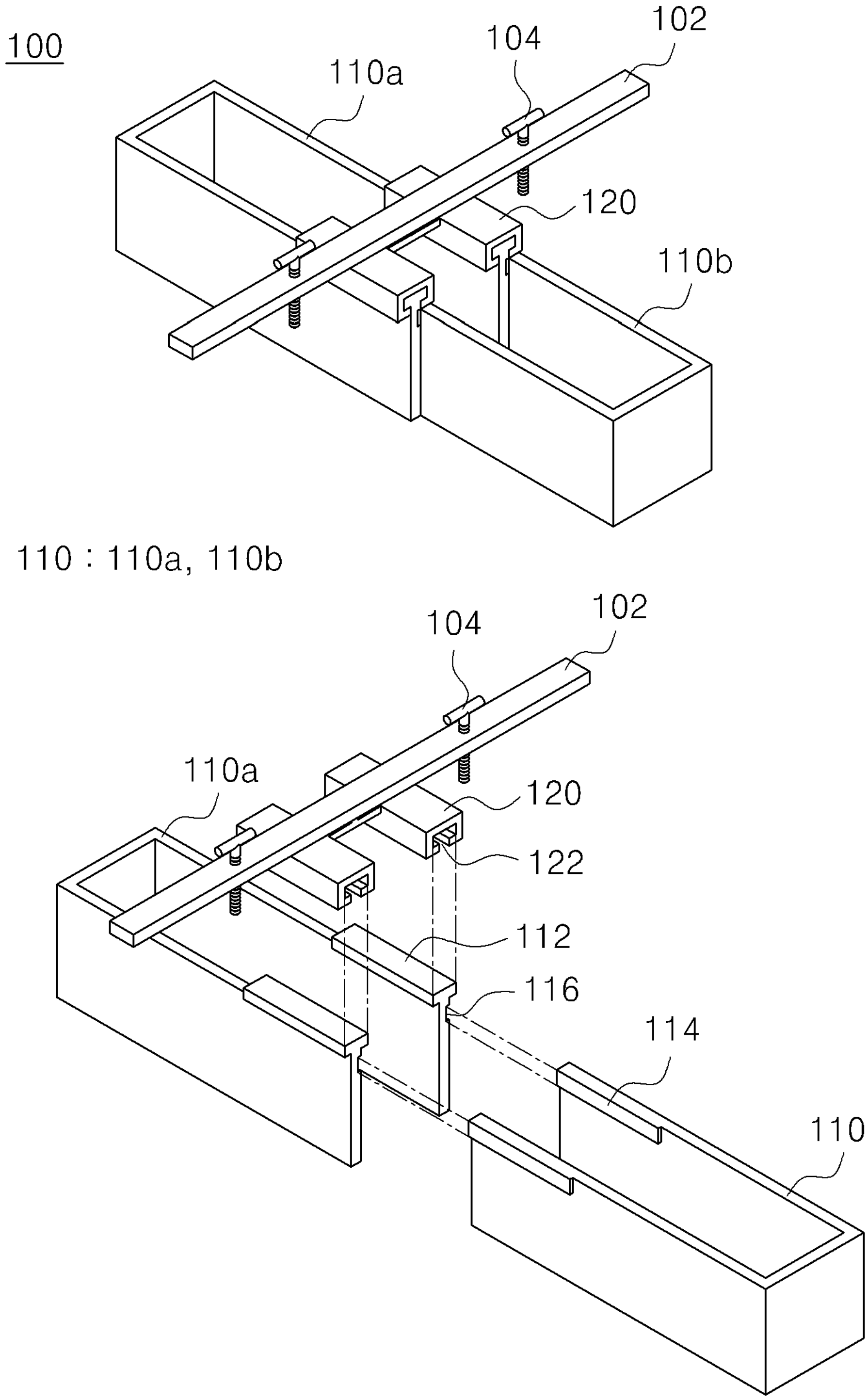

100
104
102
110a
120
110b
110 : 110a, 110b
104
102
110a
120
122
112
116
114
110b

Fig.6

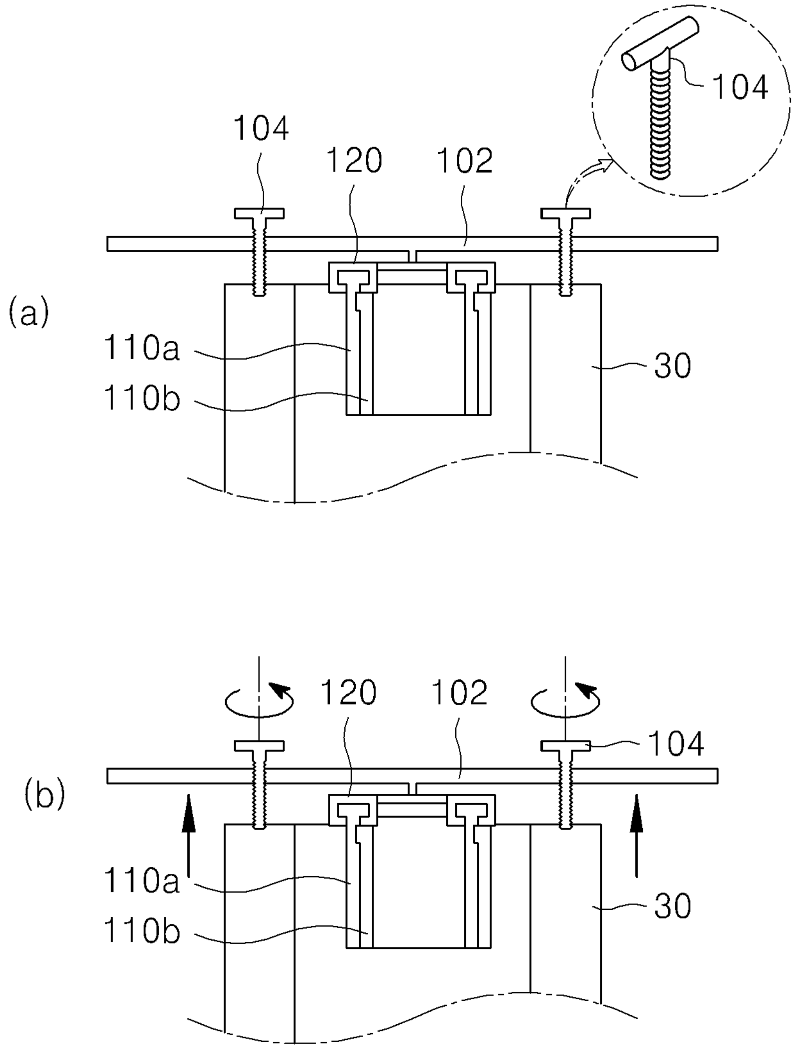


Fig.7

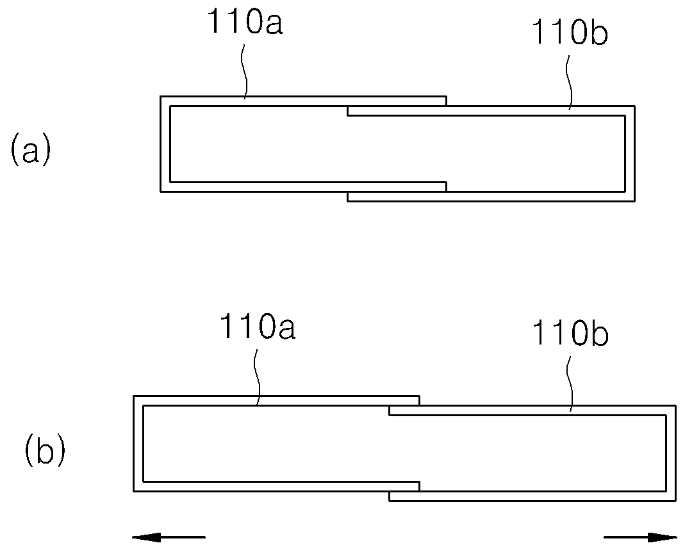


Fig.8

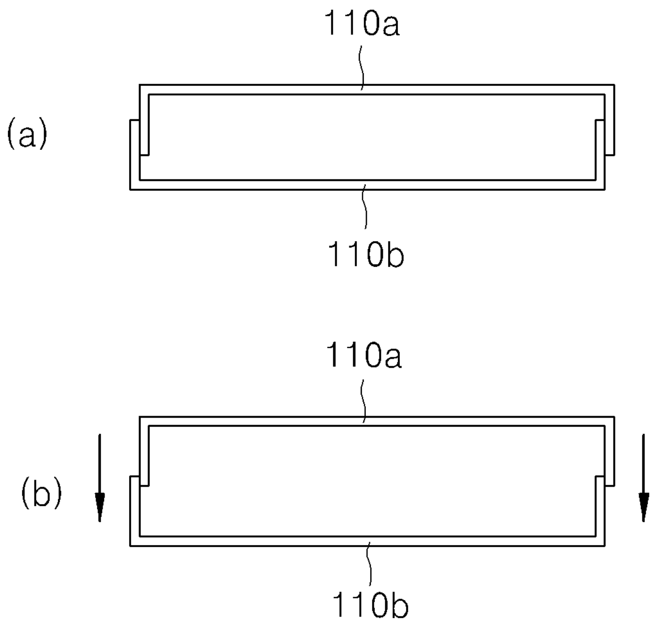


Fig.9

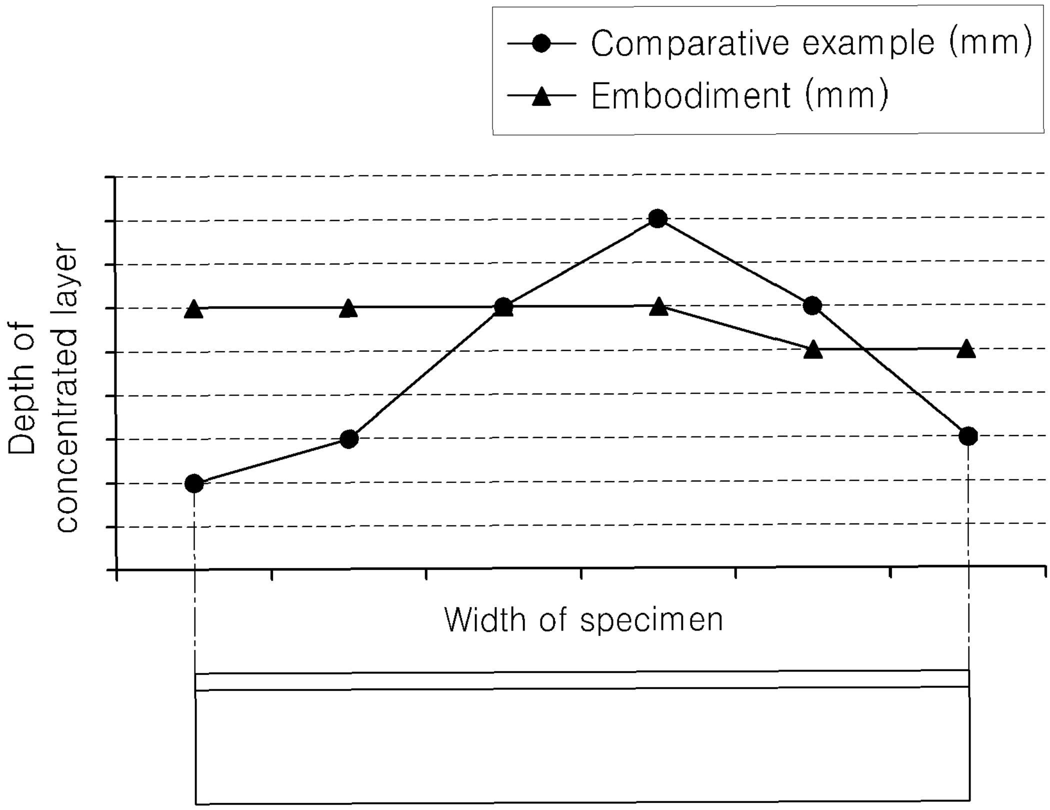
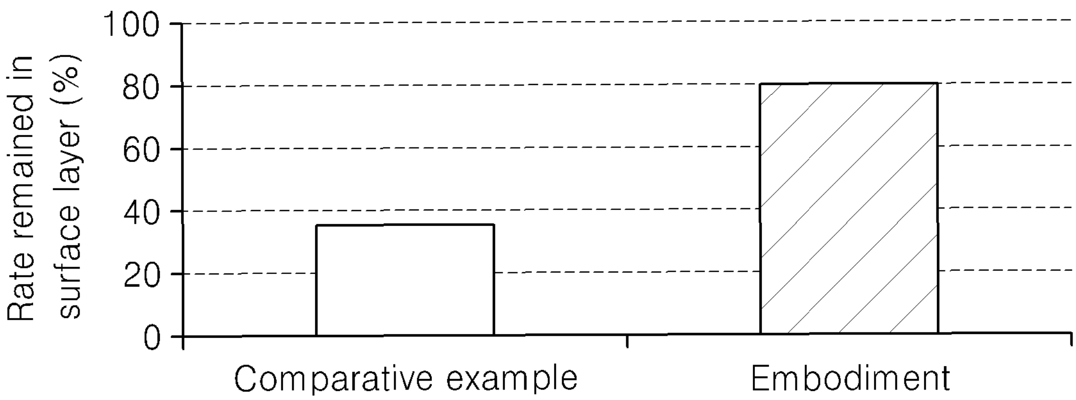

Comparative example (mm)
Embodiment (mm)
Depth of concentrated layer
Width of specimen

Fig.10


100
80
60
40
20
0
Rate remained in surface layer (%)
Comparative example
Embodiment

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2017/011634

A. CLASSIFICATION OF SUBJECT MATTER

B22D 11/06(2006.01)i, B22D 11/103(2006.01)i, B22D 11/11(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B22D 11/06; B22C 9/06; B22D 11/04; B22D 11/059; B22D 11/00; B22D 11/10; B22C 21/12; B22D 11/108; B22D 11/103; B22D 11/11

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS (KIPO internal) & Keywords: casting, mold, support, fixing, partition wall, support, flux

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-0530051 B1 (POSCO) 22 November 2005 See paragraphs [0030]-[0040], claims 1-5 and figure 1.	1,2,4,8-19
A		3,5-7
Y	KR 20-2009-0005106 U (HYUNDAI STEEL COMPANY) 27 May 2009 See paragraphs [0024], [0025] and figures 2, 3.	1,2,4,8-11,13-16
Y	JP 2005-211924 A (JFE STEEL K.K.) 11 August 2005 See paragraphs [0023], [0028], claims 1-3 and figures 1, 2.	12-19
A	JP 2007-144513 A (NIPPON STEEL CORP.) 14 June 2007 See paragraphs [0031]-[0039] and figure 2.	1-19
A	KR 10-0775089 B1 (POSCO) 08 November 2007 See paragraphs [0025]-[0028] and figure 5.	1-19

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 JANUARY 2018 (23.01.2018)	**23 JANUARY 2018 (23.01.2018)**

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2017/011634

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KR 10-0530051 B1	22/11/2005	KR 10-2003-0005938 A	23/01/2003
KR 20-2009-0005106 U	27/05/2009	KR 20-0445383 Y1	23/07/2009
JP 2005-211924 A	11/08/2005	NONE	
JP 2007-144513 A	14/06/2007	JP 04932428 B2	16/05/2012
KR 10-0775089 B1	08/11/2007	NONE	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 20120053742 **[0006]**
- KR 1349918 **[0006]**
- KR 1371959 **[0006]**